

# Briefing on IPCC Fourth Assessment Report, Working Groups I & II

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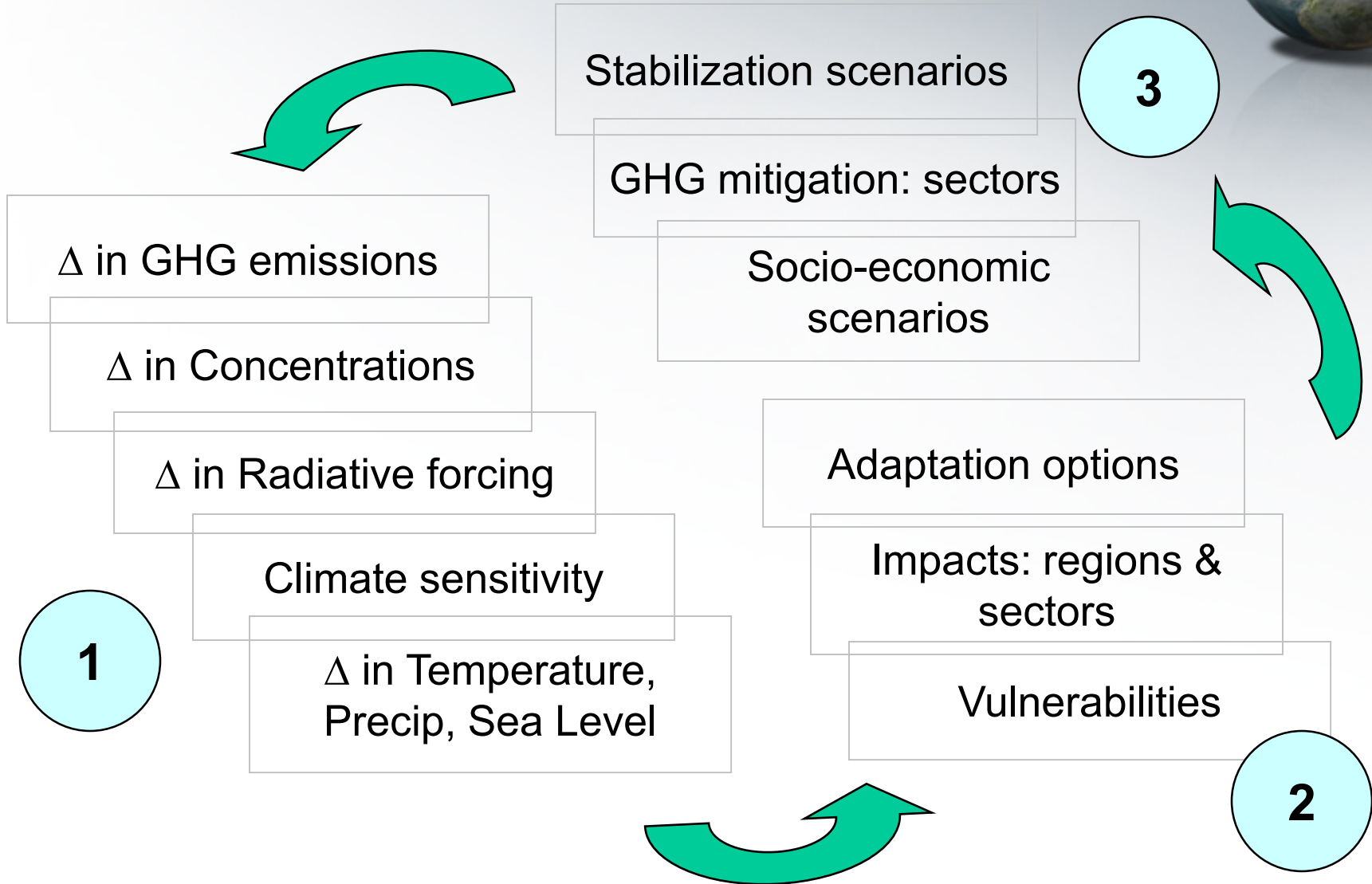
# *IPCC Fourth Assessment Report (AR4) Schedule*



<u>Working Group I (WGI)</u> <i>Physical Science</i>	<u>Working Group II (WGII)</u> <i>Impacts, Adaptation, and Vulnerability</i>	<u>Working Group III (WGIII)</u> <i>Mitigation</i>
Summary for Policymakers, or SPM, approved (Feb. 1)	SPM approved (April 6)	SPM to be approved (May 4)

**November 2007:  
*IPCC Synthesis Report***

# Scope of IPCC Working Groups I, II and III





*Each Summary for Policymakers is approved line by line by government delegations*





# ***IPCC Statements of Likelihood and Levels of Confidence for WG1 & WG2***



- Likelihood indicators
  - Extremely likely: >95% (probability of occurrence)
  - Very likely: >90%
  - Likely: >66%
  - More likely than not: >50%
  - Very unlikely: <10%
  - Extremely unlikely: <5%
- Confidence indicators
  - Very high confidence: At least a 9/10 chance (of being correct)
  - High confidence: About a 8/10 chance
  - Medium confidence: About a 5/10 chance
  - Low confidence: About a 2/10 chance
  - Very low confidence: Less than a 1/10 chance

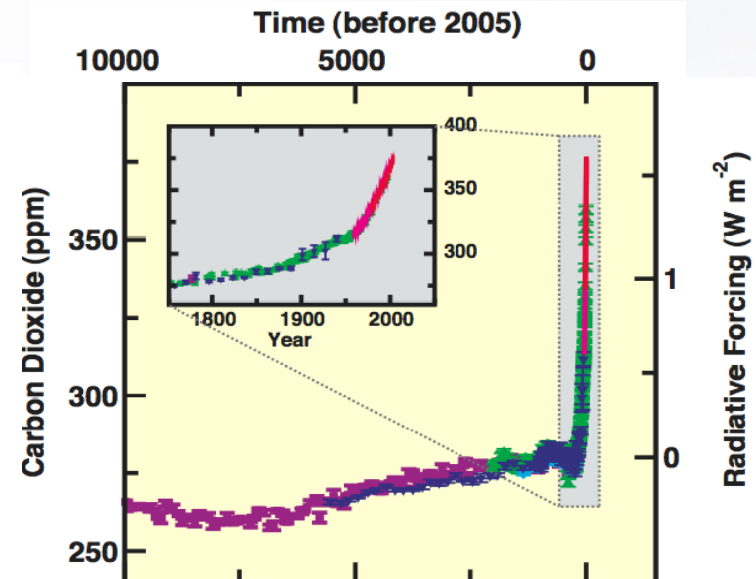
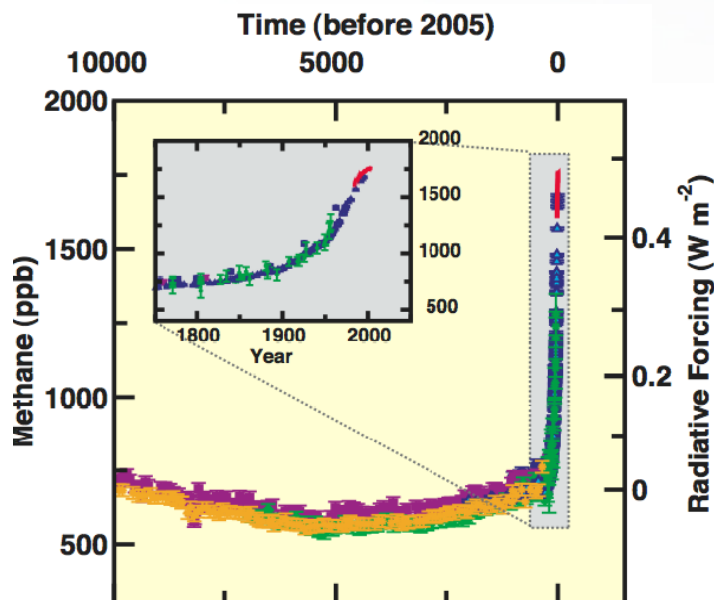
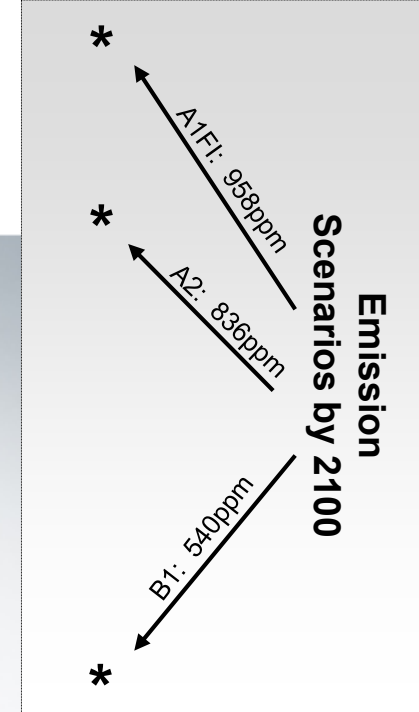
# *Contents of IPCC Working Group I Report*



- Summary for Policymakers
- Technical Summary
- Historical Overview of Climate Change Science
- Changes in Atmospheric Constituents and Radiative Forcing
- Observations: Surface and Atmospheric Climate Change
- Observations: Changes in Snow, Ice and Frozen Ground
- Observations: Oceanic Climate Change and Sea Level
- Paleoclimate
- Couplings Between Changes in the Climate System and Biogeochemistry
- Climate Models and their Evaluation
- Understanding and Attributing Climate Change
- Global Climate Projections
- Regional Climate Projections
- List of Authors, Reviewers and their Affiliations

# ***CO<sub>2</sub> & CH<sub>4</sub> Concentrations: Historic, Present and Projected***

Atmospheric concentrations of CO<sub>2</sub> and CH<sub>4</sub> in 2005 far exceeded the natural range over the last 650,000 years.

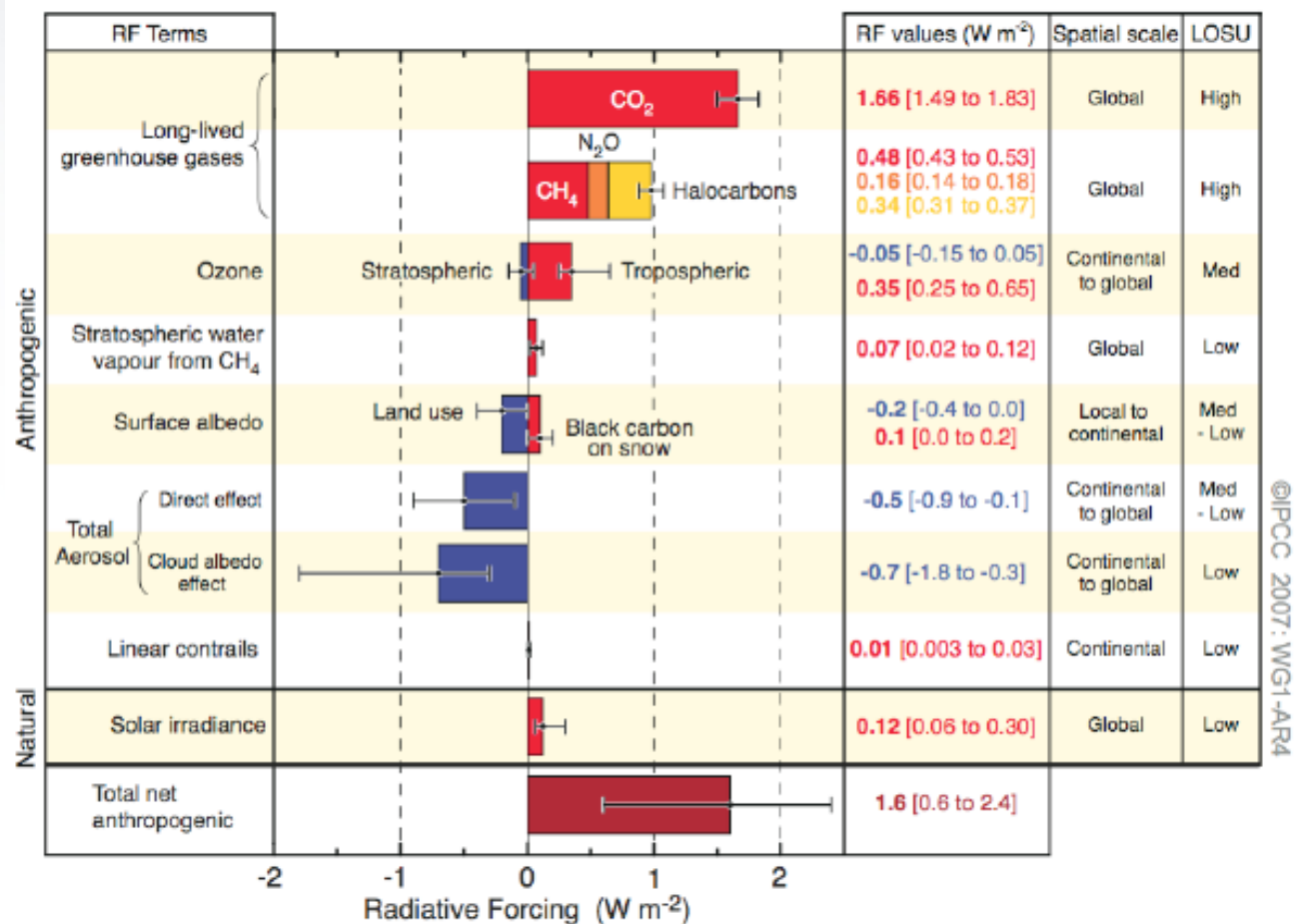


Source:  
IPCC WGI  
AR4, 2007.

# Radiative Forcing Effects of GHGs & Aerosols



- Understanding of anthropogenic warming and cooling influences on climate has improved.
- Very high confidence that net effect of human activities since 1750 has been one of warming, with a radiative forcing of  $+1.6 \text{ W/m}^2$ .

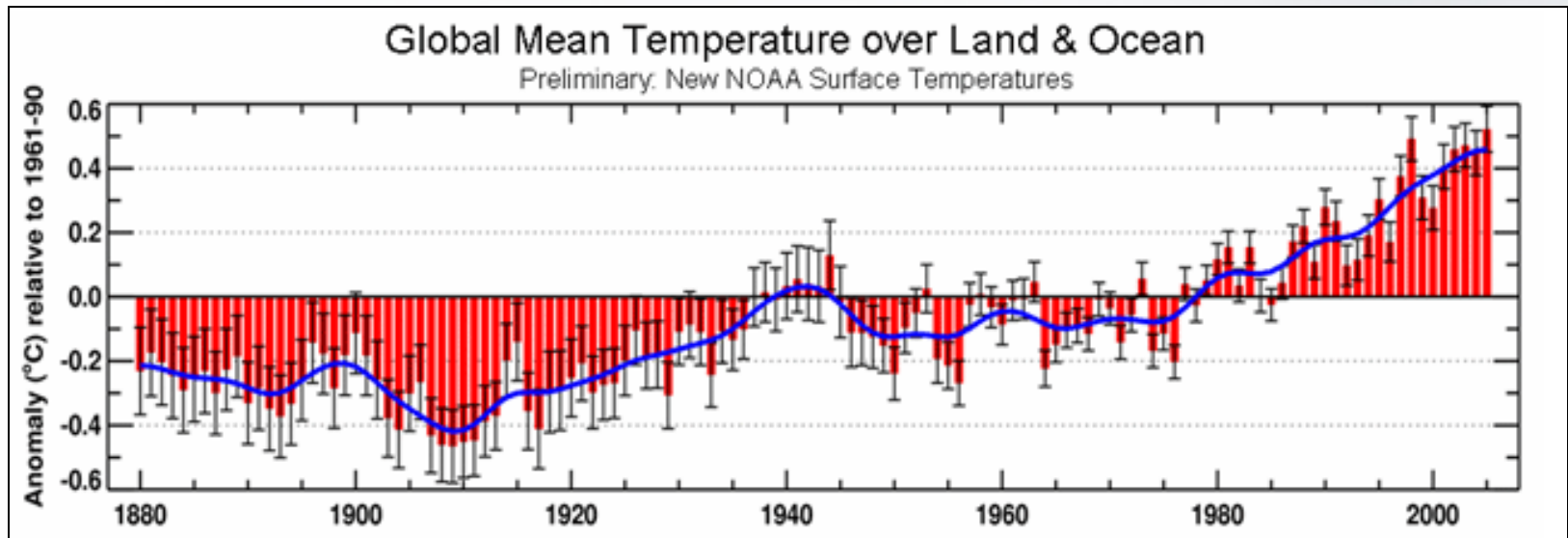




# Observed Global Warming



*Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level*

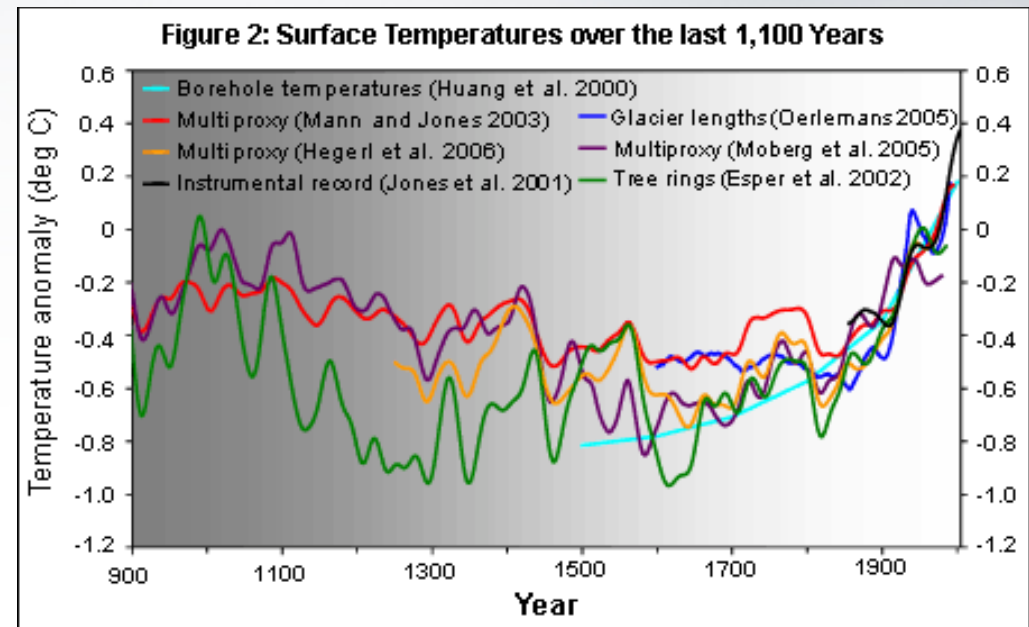


Global average warming in the past century is  $0.74^{\circ}\text{C}$  ( $1.3^{\circ}\text{F}$ )

# Paleoclimate Record for Temperatures



- Average Northern Hemisphere temperatures during the second half of the 20th century were:
  - very likely higher than during any other 50-year period in the last 500 years
  - likely the highest in at least the past 1300 years

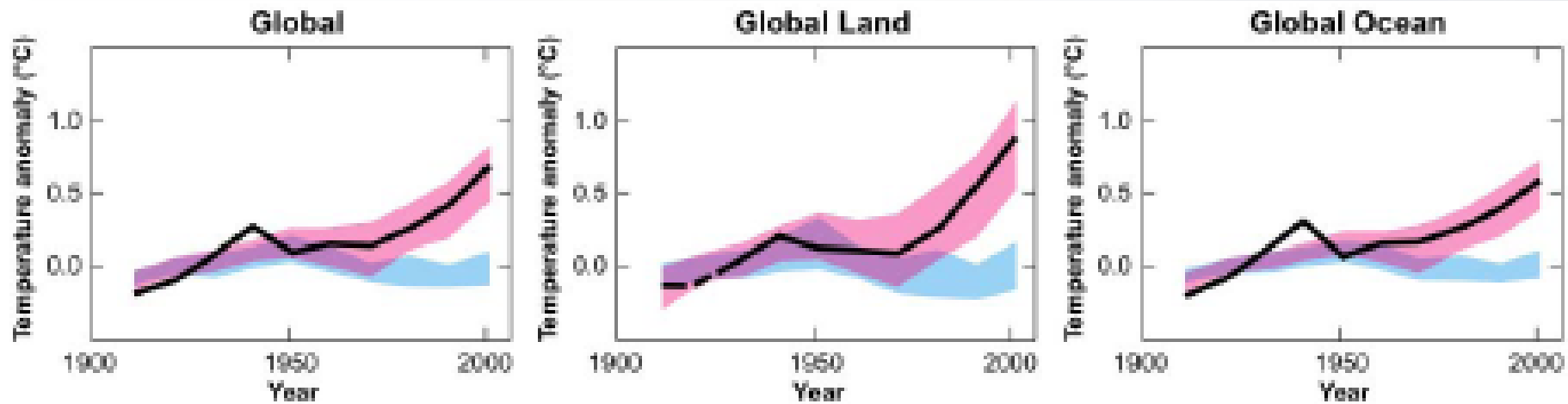


Source: NRC, 2006.

# Attribution of Observed Global Warming to Anthropogenic Emissions



*Most of the observed increase in globally averaged temperatures since the mid 20th century is very likely due to the observed increase in anthropogenic GHG concentrations*



Black line is observed warming

Blue area is 5-95% range from 5 climate models using only natural forcings

Red area is 5-95% range from 14 climate models using both natural and anthropogenic forcings

# Future Global Temperature Projections



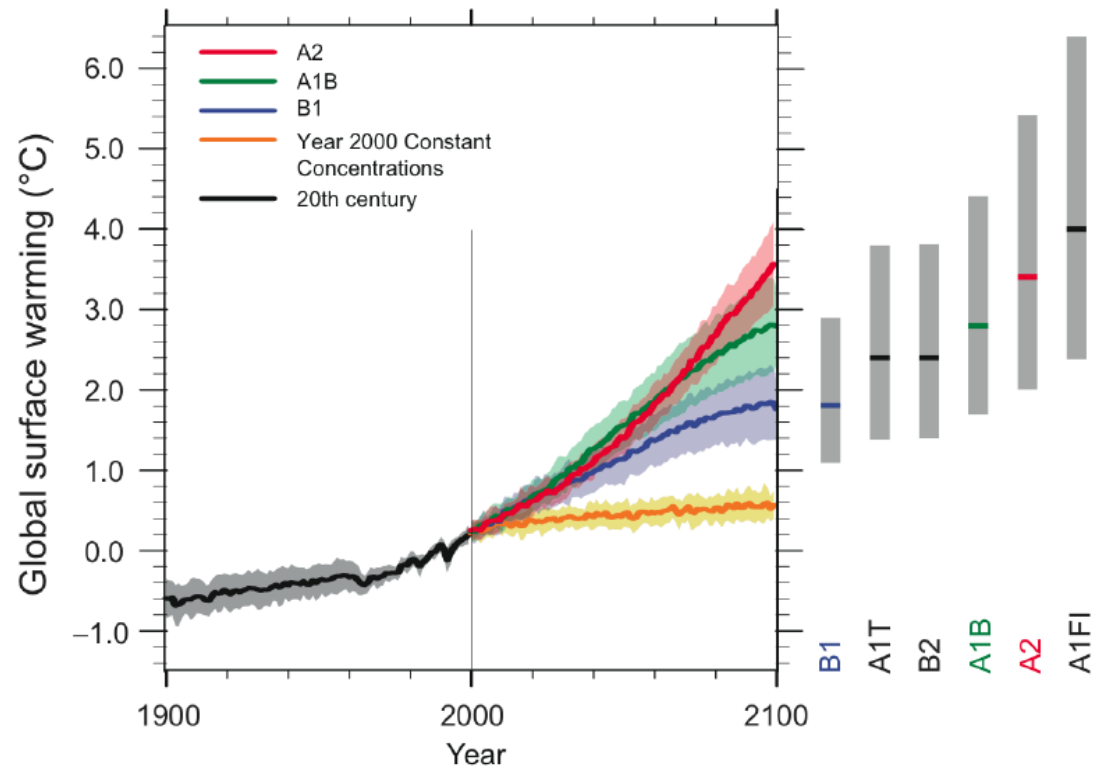
*Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.*

IPCC global temperature projections by 2100 relative to 1990:

Best estimate = 1.8 to 4.0°C (3.2 – 7.2°F)

Likely range = 1.1 to 6.4°C (2.0 – 11.5°F)

Under the IPCC 'business-as-usual' emission scenarios, warming and sea level rise would continue for centuries beyond 2100





# Future Sea Level Rise Projections



Case	Temperature Change (°C at 2090-2099 relative to 1980-1999) <sup>a</sup>		Sea Level Rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	Likely range	Model-based range excluding future rapid dynamical changes in ice flow
Constant Year 2000 concentrations <sup>b</sup>	0.6	0.3 – 0.9	NA
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

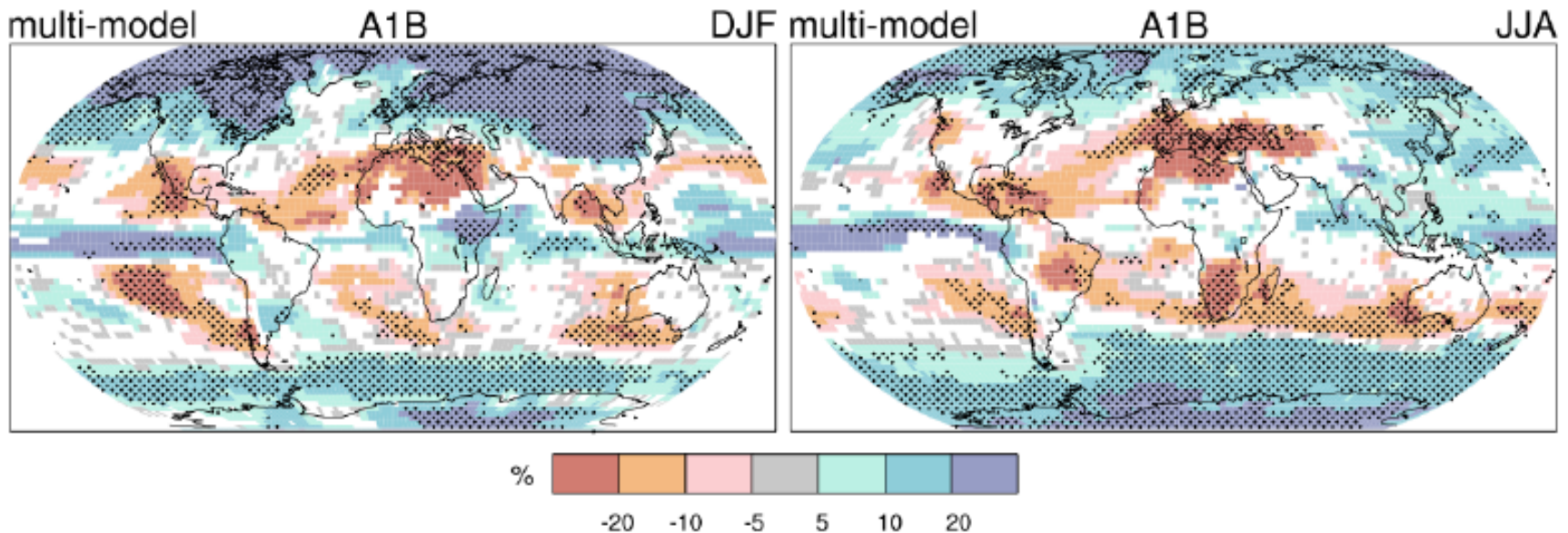
- Estimates do NOT include the increased ice discharge from Antarctic and Greenland ice sheets.
- This could add 0.1 to 0.2 m to the upper range of sea level rise projections.

# Projected Precipitation Changes



*“Since the TAR there is an improving understanding of projected patterns of precipitation. Increases in amount of precipitation are very likely in high-latitudes, while decreases are likely in most subtropical regions.”*

## PROJECTED PATTERNS OF PRECIPITATION CHANGES



# Contents of IPCC Working Group II Report



- **Summary for Policymakers**
- **Technical Summary**
- **Assessment of Observed Changes**
  - Assessment of Observed Changes and Responses in Natural and Managed Systems
- **Assessment of Future Impacts and Adaptation: Systems and Sectors**
  - New Assessment Methodologies and the Characterization of Future Conditions
  - Fresh Water Resources and Their Management
  - Ecosystems, Their Properties, Goods and Services
  - Food, Fiber and Forest Products
  - Coastal Systems and Low-lying Areas
  - Industry, Settlement and Society
  - Human Health
- **Assessment of Future Impacts and Adaptation: Regions**
  - Africa
  - Asia
  - Australia and New Zealand
  - Europe
  - Latin America
  - North America
  - Polar Regions
  - Small Islands
- **Assessment of Responses to Impacts**
  - Assessment of Adaptation Practices, Options, Constraints, and Capacity
  - Inter-relationships between Adaptation and Mitigation
  - Assessing Key Vulnerabilities and the Risk from Climate Change
  - Perspectives on Climate Change and Sustainability

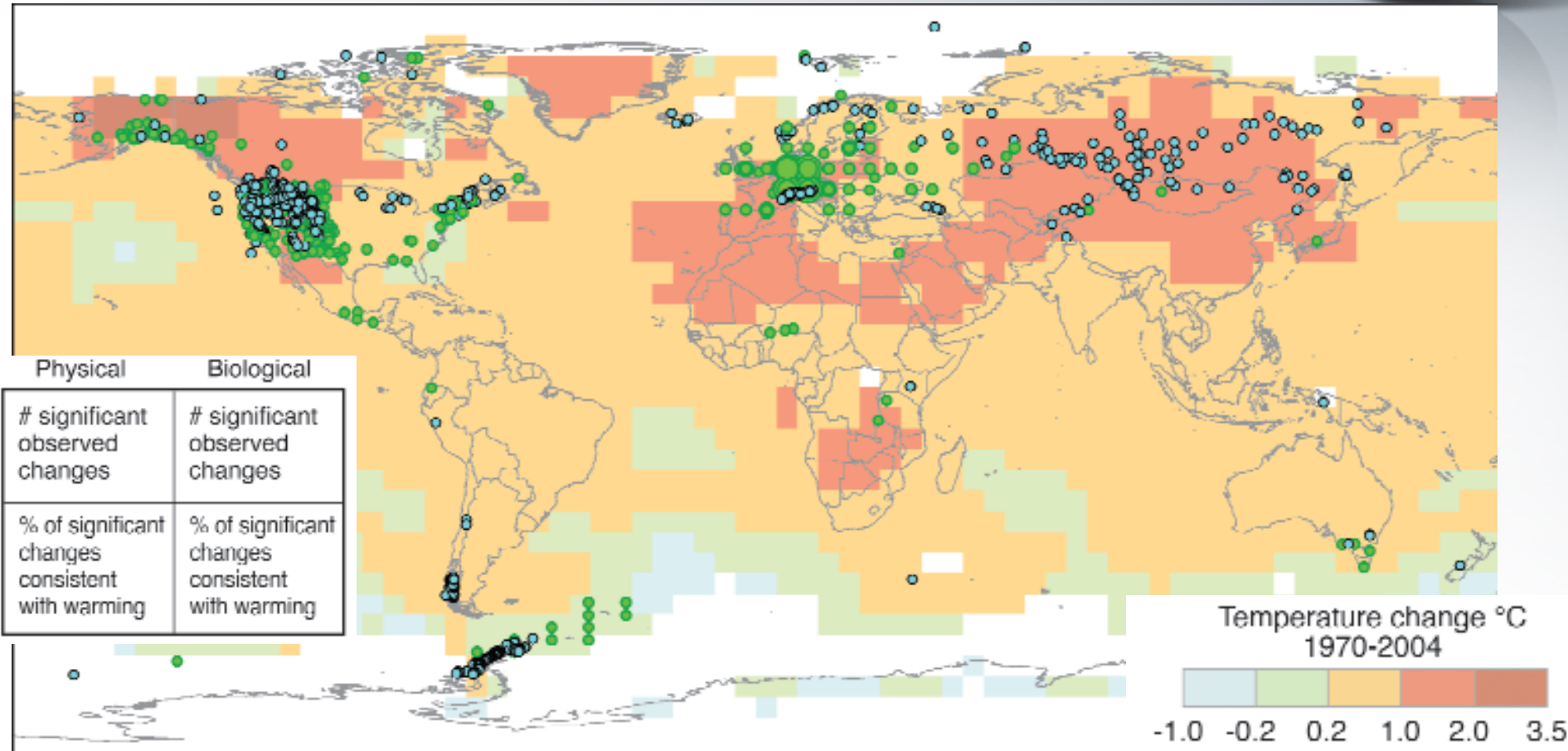
## WGII: Key Findings on Climate Change Impacts, Adaptation and Vulnerability



- More confident assessment of the relationship between observed warming and observed changes in physical and biological systems
- Greater confidence in ability to systematically estimate magnitude of impacts at different ranges of increases in global average temperature.
- *“Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions.”*
- *“Future vulnerability depends not only on climate change but also on development pathway.”*
- *“Impacts of climate change will vary regionally but, aggregated and discounted to the present, they are very likely to impose net annual costs which will increase over time.”*



*“...likely that anthropogenic warming has had a discernible influence on many physical and biological systems.”*



NAM	LA	EUR	AFR	AS	ANZ	PR*	TER	MFW**	GLO
355 455	53 5	119 28,115	5 2	106 8	6 0	120 24	764 28,586	1 85	765 28,671
94% 92%	98% 100%	94% 89%	100% 100%	96% 100%	100% -	91% 100%	94% 90%	100% 99%	94% 90%

# ***Attributing observed changes to anthropogenic climate change is more difficult certain systems***



*Other effects of regional climate changes on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.*

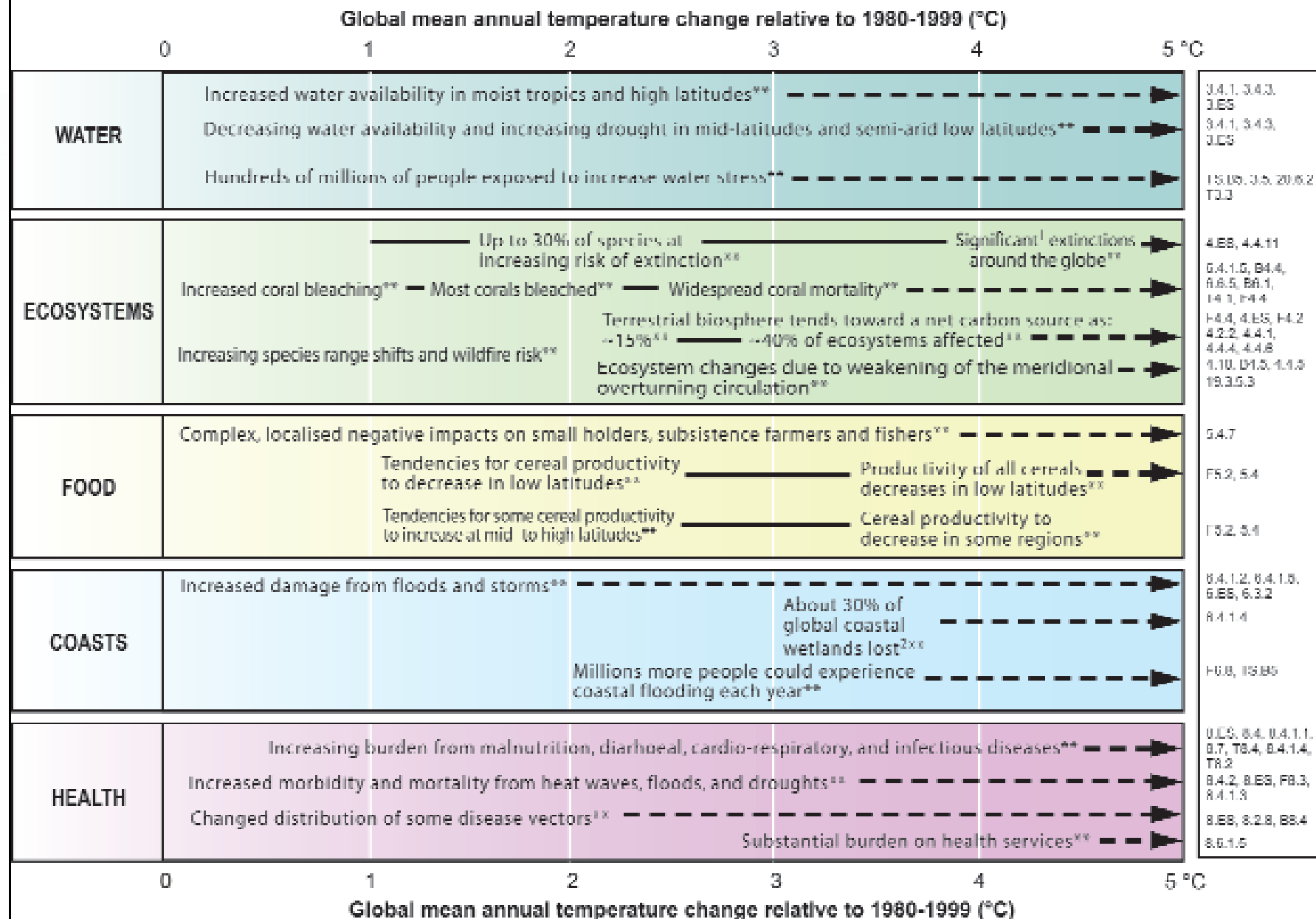
- Examples of other observed changes that IPCC has not definitively attributed to anthropogenic climate change:
  - Earlier spring planting of crops in the northern hemisphere
  - Heat-related mortality trends in Europe
  - In the Sahel region of Africa, warmer and drier conditions have led to reduced length of growing season
  - Sea-level rise and human development are together contributing to losses of coastal wetlands and mangroves

# Examples of future impact statements by sector



- **Health**
  - Projected climate change-related exposures are likely to affect the health status of millions of people, particularly those with low adaptive capacity, through:
    - increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts;
    - the increased frequency of cardio-respiratory diseases due to higher concentrations of ground level ozone related to climate change;
- **Ecosystems**
  - The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land use change, pollution, over-exploitation of resources).
- **Water**
  - By mid-century, annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water stressed areas.

**Key Impacts as a Function of Increasing Global Average Temperature Change**  
(Impacts will vary by extent of adaptation, rate of temperature change, and socio-economic pathway)



<sup>1</sup> Significant is defined here as more than 40%.

<sup>2</sup> Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080.



# *The potential costs of impacts*



- “...re-confirm evidence reported in the Third Assessment that, while developing countries are expected to experience larger percentage losses, global mean losses could be 1-5% Gross Domestic Product (GDP) for 4°C of warming.”
- Social cost of carbon (SCC):
  - Future net benefits and costs associated with climate change that are discounted to the present
  - Survey of 100 estimates: values ran from US\$-3/tCO<sub>2</sub> up to \$130/tCO<sub>2</sub>
  - Peer-reviewed estimates have an average value of \$12/tCO<sub>2</sub>, with a significant range

# WGII: North American Chapter

## Direct statements from Executive Summary



- *The vulnerability of North America depends on the effectiveness and timing of adaptation and the distribution of coping capacity, which vary spatially and among sectors.*
- *Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution.*
- *Climate change will constrain North America's already heavily utilized water resources, increasing competition among agricultural, municipal, industrial, and ecological uses.*
- *Climate change impacts on infrastructure and human health and safety in urban centers will be compounded by aging infrastructure, maladapted urban form and building stock, urban heat islands, air pollution, population growth, and an aging population.*
- *Without increased investments in countermeasures, hot temperatures and extreme weather are likely to cause increased adverse health impacts from heat-related mortality, pollution, storm-related fatalities and injuries, and infectious diseases.*
- *Disturbances like wildfire and insect outbreaks are increasing and are likely to intensify in a warmer future with drier soils and longer growing seasons.*

# IPCC WG1 & WG2 Talking Points



- The [IPCC Working Group I](#) report assesses the current scientific knowledge of the natural and human drivers of climate change, observed changes in climate, the ability of science to attribute changes to different causes, and projections for future climate change that include temperature, precipitation and sea level rise.
- Greenhouse gas concentrations have markedly increased since 1750 and far exceed pre-industrial values.
- Temperatures are increasing, sea levels are rising and ice is melting. The warming of the climate system is "unequivocal."
- Human activities have *very likely*<sup>1</sup> caused most of the warming over the past 50 years.
- Improved computer modeling has increased confidence in future climate projections: temperatures will continue to increase, sea levels will continue to rise, and ice will continue to melt.
- The [IPCC Working Group II](#) report assesses current scientific understanding of impacts of climate change on natural and human systems, their capacity to adapt and their vulnerability.
- Evidence from many parts of the world show that people, plants and animals are being affected by regional climate changes, particularly temperature increases.
- Warming caused by human activities has *likely*<sup>1</sup> had a discernible influence on plants and animals.
- More detailed information is now available about how climate change will impact water resources, ecosystems, agriculture and forestry, health, coastlines and regions of the world. These impacts will likely be both positive and negative across regions although it is *very likely*<sup>1</sup> that all regions will experience declines in benefits or increases in costs if global average temperatures warm more than 3.6-5.4 degrees F.
- A mix of adaptation (preparing for and responding to climate change impacts) and mitigation (e.g. reducing greenhouse gas emissions) can reduce the risks of climate change.